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14. ABSTRACT

DoD makes use of five different distribution channels to sustain U.S. military forces overseas. Three are air delivery channels and two are by sea. These channels offer varying speeds of delivery and have different costs. In addition to these variables, there are certain practical constraints that must be taken into account in making choices among channels, and for surface transportation, the marginal cost of additional inventory must also be considered. In this briefing, we analyze the implications of all these factors for how the channels should be used--which transportation modes should be chosen and where materiel should be stocked--to provide effective support as efficiently as possible. We describe the distribution choices for some illustrative units in Iraq and compare them with the ideal model resulting from our analysis. We find that, through gradual evolution, the sustainment structure for Iraq is beginning to match the model. We offer several guidelines for improving sustainment in the near term by bringing current practices closer to the ideal.

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DOCUMENTED BRIEFING

Leveraging Complementary Distribution Channels for an Effective, Efficient Global Supply Chain

Eric Peltz, Marc Robbins

Prepared for the United States Army

RAND ARROYO CENTER

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Preface

This documented briefing (DB) first describes the major distribution channels used to sustain U.S. military forces overseas. Then it discusses their capabilities and characteristics, how their performance depends upon integration with inventory positioning, and how these factors determine the ways the channels should be used to provide effective support as efficiently as possible. It also lays out how well the sustainment of units in Iraq reflects the ideal supply chain structure derived from the distribution channel analysis. Finally, this documented briefing offers paths to more effective and more efficient support by examining how ongoing sustainment could move closer to the ideal.

This research and document builds upon a briefing presented at the 2006 Association of the United States Army Logistics Symposium. It is derived from RAND Arroyo Center and National Defense Research Institute research sponsored over several years by the U.S. Army, the Defense Logistics Agency, and the U.S. Transportation Command, as well as earlier research on "OIF Logistics: Key Issues for the Army" that is documented in a RAND Arroyo Center report entitled *Sustaining Army Forces in OIF: Major Findings and Recommendations*. After the symposium, the briefing was further developed as part of a project on "Supply Chain Integration with Government Providers," sponsored by the U.S. Army Materiel Command and the Deputy Chief of Staff, G-4, U.S. Army. This project was conducted by RAND Arroyo Center's Logistics Program. RAND Arroyo Center, part of the RAND Corporation, is a federally funded research and development center sponsored by the United States Army.

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Contents

Summary

When transportation and stock positioning decisions are well integrated, enabling the resulting distribution channels to be used in ways that leverage their strengths, the channels become complementary elements of an effective, efficient global supply chain. The Department of Defense's inventory locations and transportation channels combine to form five major distribution channels for materiel shipped from the Continental United States (CONUS) to other theaters:

- Military air with shipments consolidated at distribution centers (MILALOC).
- Military air with shipments consolidated at airports (MILAIR).
- Commercial express small package delivery or Worldwide Express (WWX).
- Ocean lift to theater inventory with theater distribution ("Surface-theater").
- Ocean lift with transshipment to the unit ("Surface-direct").

Distribution Channel Characteristics and Performance

These channels offer varying levels of service and shipping cost, as demonstrated by service to units in Iraq. MILALOC, when materiel is issued from the primary distribution center supporting a unit/theater, offers fast service at a moderate cost. The speed is similar to that of WWX, which costs much more than MILALOC in undeveloped theaters. Surface-theater also has similar speed, at about half the cost of MILALOC. So, for example, to support customers in Iraq, there are three fast channels at different transportation "price points." In contrast, when the shipment is issued from the nonprimary distribution center, MILAIR and MILALOC are slower, with moderate transportation cost. Surface-direct is very slow but also very inexpensive.

The performance and transportation costs for each channel are not alone sufficient to determine whether one channel or another should be used. Rather, there are "prerequisites" for either feasibility or effectiveness. For

MILALOC to be effective, a unit has to need enough sustainment materiel for reasonably full air pallets to be shipped to it on a frequent basis; moreover, the materiel needs to be positioned at the primary distribution center supporting the unit. Also, a small percentage of items are not eligible to be packaged for air shipment at distribution centers, precluding the use of MILALOC for these items. WWX is currently limited by contract to items 150 lbs. or less.

When considering sealift combined with centralized theater inventory, the marginal cost of additional inventory must be considered along with transportation cost. Good candidates for sustainment from centralized theater inventory with replenishment by sea are items that have a high ratio of weight (a proxy for transportation cost) to their procurement cost. Total sustainment cost is reduced when high weight-to-cost materiel is stocked in theater and replenished by ship. Thus, surface-theater and MILALOC offer similar performance but are uniquely cost-effective for different items. Finally, surface-direct is too slow and variable to be used except for cases in which delivery timing is not important or planning offers a long lead time.

Ideal Distribution Channel Roles

The combinations of performance, transportation cost, inventory cost, and conditions under which the channels are feasible and effective lead to ideal roles for each. Surface-direct is best for relatively low-cost items ordered in bulk either for time-insensitive needs or when the unit can plan far in advance. Surface-theater is the best way to provide high-volume, high-weight-to-cost items to all units in theater.[1] Time-sensitive demands for items for which it is

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[1] For units in Iraq, theater inventory has not been providing a time advantage over MILALOC from the primary distribution center. Thus, it has primarily offered a transportation cost savings. However, if in another theater it were to have a time advantage, then it could be advantageous to expand the breadth of items to improve customer support effectiveness. Similarly, it can provide a time benefit for items that cannot use MILALOC from the primary distribution center or WWX. In such cases, if the item does not meet the weight-to-cost criteria for theater inventory, then it may still be beneficial to hold it in theater inventory but with air-based replenishment to hold down inventory requirements.

not cost-effective from a total cost perspective to hold in theater inventory should be sent by air from CONUS.

MILALOC is fast and relatively inexpensive and is the ideal choice for moderate- to high-volume units when stock is positioned to a large degree at the unit's primary supporting distribution center. Even for these units, though, MILALOC cannot handle all items, requiring a fallback to MILAIR. Also, some stock will not be in the right place for MILALOC customers; in this situation, WWX becomes an alternative for fast, reliable distribution. For units with low volume or stock positioning that will not support effective MILALOC, the only way to get fast, reliable distribution is WWX. For items over 150 lbs. sourced from within CONUS, though, these units then have to rely on relatively slow MILAIR.

Thus, customers get responsive distribution—fast and reliable—and total system costs are minimized when high-volume, high-weight-to-cost items are stocked in theater with replenishment by ship, most items for higher-volume customers are stocked at their supporting distribution centers, and customers plan activities involving large volumes of inexpensive materiel far in advance.

Ideal Roles vs. Current Sustainment Structure: Iraq as a Case Study

Through a gradual evolution, the sustainment structure for Iraq has moved toward this supply chain model. To illustrate this, we look at the sustainment channels serving example units representing different unit types in Iraq, and we also look at whether surface-theater is being employed for high-volume, high-weight-to-cost items.

When shipping volume from a primary distribution center in CONUS is high enough—driven by the combination of unit sustainment demand volume and stock positioning effectiveness, the best distribution choice for items shipped from CONUS to units in Iraq is MILALOC. To determine whether a unit demands sufficient volume, we first look at total volume per day. The next check is to see how much of these items in terms of weight are issued from the unit's primary distribution center in CONUS. The third check is to see how much of the materiel shipped from the primary distribution center is MILALOC-eligible. If the result of these three checks is that there is sufficient volume for approximately daily pallets from a unit's primary distribution center, then MILALOC should be employed.

For an Army heavy brigade combat team (BCT) example, all three MILALOC criteria are fulfilled. Thus, as it should be, MILALOC is the primary CONUS channel for the BCT. Because the BCT also requests many big, heavy items, surface-theater is also an appropriate major channel.

An illustrative Army combat aviation brigade (CAB) has relatively high volume, but the stock positioning of the items it needs meshes only moderately with the use of MILALOC. So while it uses MILALOC, it is also supported with WWX for small items. WWX is its highest-frequency channel.

An illustrative U.S. Air Force base supply unit has relatively low volume and similar stock positioning at the primary distribution center as the Army CAB. This combination prevents consideration of MILALOC for this unit. Thus, the primary mode from CONUS is WWX, with MILAIR as the fallback for larger items.

An illustrative U.S. Marine Corps aviation logistics unit actually has relatively high volume, but a small fraction of its shipments in terms of weight are from the primary distribution center. This would make MILALOC ineffective. Hence, it too uses WWX as the primary mode. Unlike the other units, it does not utilize theater inventory.

The sustainment structure for Iraq also generally reflects the ideal supply chain model when viewed from an item perspective. For the top 100 items by shipping weight, most with high weight-to-cost ratios are now stocked in theater. However, forward theater inventory remains more hit and miss for the next 900 items.

Improvement Opportunities

There are near-term opportunities for improved, cost-effective sustainment by more effectively leveraging the complementary nature of the five available distribution channels.

- First, better stock positioning to improve MILALOC effectiveness and utilization would reduce overall distribution times.
- Support to MILALOC units can be improved by using WWX to ship

small, critical items not at the primary distribution center, after improving stock positioning.

- The potential for heavier WWX weight limits should also be explored to mitigate the effects of relatively slow MILAIR performance for units for which WWX is the primary channel.
- Still, there will continue to be critical, large items that demand MILAIR. Support for these items will continue to suffer unless MILAIR is improved, an alternative channel such as a special charter is established, or forward stock positioning is leveraged.
- Additionally, there remain some high-volume, high-weight-to-cost items that should be stocked in centralized theater inventory to reduce total costs.

In conclusion, the five distribution channels discussed in this report are not redundant, but rather play important, complementary roles in providing cost-effective support to soldiers, sailors, airmen, and marines around the world. With these roles well understood, all of the organizations involved in their operation and use will be better able to integrate the supply chain and determine the best paths to improved support.

Acknowledgments

This documented briefing grew out of research on logistics in Operation Iraqi Freedom and a long body of research for the Army, the Defense Logistics Agency, and the U.S. Transportation Command on improving global distribution. Ken Girardini played a major role in all of these streams of research and contributed intellectually to the development of this document. Rick Eden provided valuable contributions in terms of constructing the briefing, and Pat Boren provided programming support. The data were provided by the DORRA in DLA, DAASC, USTRANSCOM, and the U.S. Army. Roger Kallock and Jim Masters reviewed the document and offered several recommendations that improved its effectiveness.

We thank the Association of the United States Army (AUSA) and the Army Materiel Command, which organized the 2006 AUSA Logistics Symposium, for inviting us to present this briefing as part of the Global Supply Chain panel and for the opportunity to contribute to the professional discussions.

Glossary

APOD	Aerial Port of Debarkation
APOE	Aerial Port of Embarkation
AUSA	Association of the United States Army
AVN	Aviation
BCT	Brigade Combat Team
BRAC	Base Realignment and Closure
CAB	Combat Aviation Brigade
CCP	Containerization and Consolidation Point
CONUS	Continental United States
DAASC	Defense Automatic Addressing Systems Center
DDC	Defense Distribution Center
DDKS	Defense Distribution Depot Kuwait, Southwest Asia
DDSP	Defense Distribution Depot Susquehanna, PA
DDRT	Defense Distribution Depot Red River
DLA	Defense Logistics Agency
DORRA	Defense Logistics Agency Office of Operations Research and Resource Analysis
DVD	Direct Vendor Delivery
FDD	Forward Distribution Depot
GSA	General Services Administration
ICP	Inventory Control Point
MILALOC	Military air with shipments consolidated at distribution centers

MILAIR	Military air with shipments consolidated at airports
NSN	National Stock Number
OIF	Operation Iraqi Freedom
RWT	Requisition Wait Time
SDP	Strategic Distribution Platform
SPOD	Seaport of Debarkation
SPOE	Seaport of Embarkation
SSA	Supply Support Activity
TACOM	Tank-automotive and Armaments Command
TDD	Time Definite Delivery
USAF	U.S. Air Force
USMC	U.S. Marine Corps
USTRANSCOM	U.S. Transportation Command
WWX	Worldwide Express

1. Leveraging Complementary Distribution Channels

RAND ARROYO CENTER

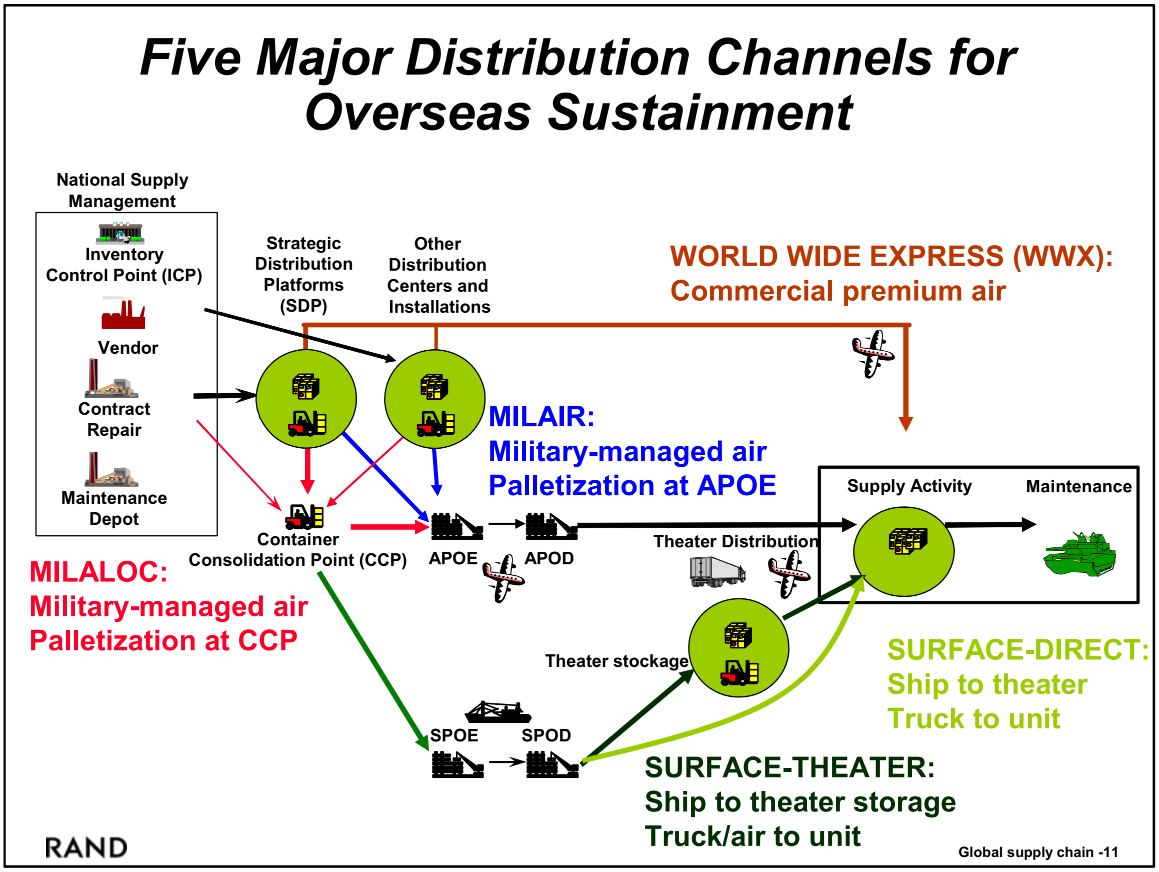
Leveraging Complementary Distribution Channels for an Effective, Efficient Global Supply Chain

21 September 2006

Eric Peltz
Marc Robbins
Ken Girardini

There are a number of different ways to ship materiel overseas to sustain U.S. military forces. There are a number of different places to stock the materiel. Together, these choices create the set of available distribution channels. When the transportation and stock positioning decisions are well integrated and the resulting channels are used in ways that leverage their individual strengths, these channels become complementary elements of an effective, efficient global supply chain.

2. Major Distribution Channels



This chart defines the major distribution channels employed for overseas sustainment of what we call “pull” items. These are the items that units requisition to fill specific needs, as opposed to “push” items that are sent to units on a regular basis for continuous use such as food, water, and fuel.

The schematic lays out the key nodes and transportation links in the sustainment system. At the beginning of the supply chain, supply managers in the Services, the Defense Logistics Agency (DLA), and the General Services Administration (GSA) determine how much inventory to hold and when to place orders to replenish stocks in order to cost-effectively meet customer needs.

These orders are placed with private-sector vendors and Department of Defense maintenance depots.[1]

Stock positioning decisions—both initial delivery locations and any repositioning—are made by the services and GSA for the items they manage and own and by DLA's Defense Distribution Center (DDC) in coordination with its defense supply centers for DLA managed and owned items. The orders are delivered to and stored in DLA distribution centers and GSA depots. The DLA distribution centers include two strategic distribution platforms (SDPs) and other more specialized distribution centers or those collocated with maintenance depots.[2]

The two SDPs have containerization and consolidation points (CCPs) for supporting overseas customers. Generally, when materiel is issued from SDP warehouses, it is moved to the collocated CCP to be consolidated on air pallets or to be put into containers for ocean shipment. Quite frequently, materiel is also sent to a CCP from the other SDP, other DLA and GSA distribution centers, or other sources of fill (to include service installation stocks), where it is consolidated with locally issued materiel for overseas shipment. The pallets and containers are trucked to either Air Mobility Command aerial ports of embarkation (APOEs) or commercial seaports of embarkation (SPOEs). In other cases, materiel is sent from distribution centers and other sources of fill directly to APOEs, bypassing the CCP.

Air Mobility Command flies the items overseas to aerial ports of debarkation (APODs), using either military aircraft or chartered private-sector aircraft. In some cases, the APODs are near the supply activity supporting the final maintenance customer, and theater units will truck the pallet to the supply activity. In other cases, the pallets are delivered to an APOD at a central

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[1] In the Army, this also includes installation repair activities as part of the National Maintenance Program.

[2] The Base Realignment and Closure (BRAC) 2005 legislation creates two new SDPs and will change the designation of other CONUS distribution centers to "forward distribution points," whose primary role will be to support collocated repair depots and issue depot-level reparables worldwide.

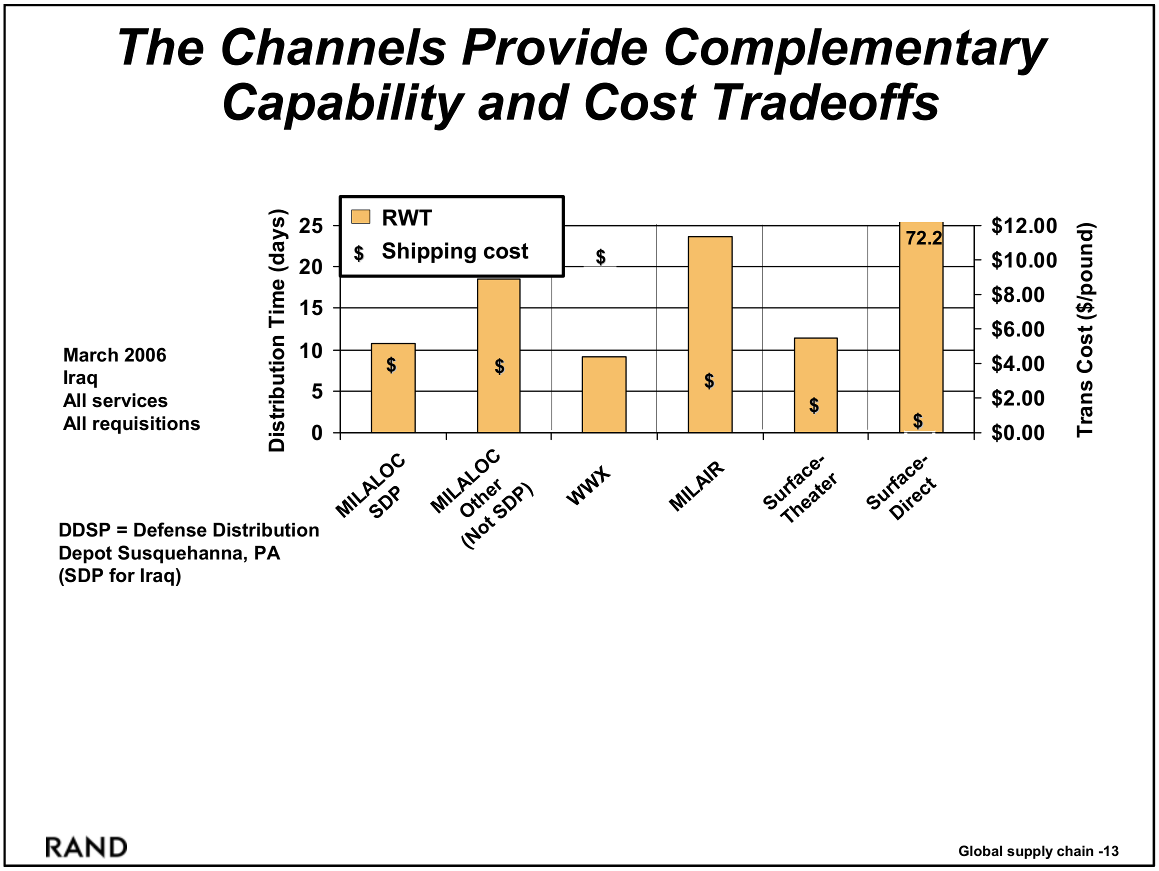
logistics hub and moved by a theater distribution system, either by air or truck, to the supply activity.

Containers with materiel for one supply activity and its customers are also delivered by the theater distribution system from the seaport of debarkation (SPOD). Many ocean shipments, though, have replenishments for centralized theater inventory such as at a forward distribution depot (FDD) managed by DLA or at a general-support supply support activity (SSA) in the Army. Items are shipped from these theater warehouses to supply activities upon demand using both intratheater air and trucks. Units handle the final movement of materiel from the final field supply activity to the customer, such as a maintenance shop.

These inventory locations and transportation channels combine to form five distribution channels. MILALOC is defined as building pallets of materiel at SDP CCPs for shipment by military-managed air. MILAIR differs from MILALOC only in that the materiel is put onto pallets at APOEs by Air Mobility Command personnel rather than at CCPs by DLA personnel. Worldwide Express (WWX) is the use of commercial premium air delivery carriers such as FedEx, DHL, and UPS through blanket contracts that are all part of the WWX program. “Surface-direct” is when materiel is moved directly from continental U.S. (CONUS) consolidation points or other distribution centers to a field supply activity via sealift and theater trucks. “Surface-theater” refers to the use of ships to deliver inventory to centralized theater stocks for delivery upon demand by truck or air.

3. Capability and Cost Tradeoffs

A. Distribution Performance and Transportation Cost



These channels offer varying levels of service and shipping cost, as shown by this graph of requisition wait time (RWT) with backorder time excluded and shipping cost for all shipments to Iraq in March 2006. RWT is the time from when an order is generated for the wholesale supply chain until it is receipted by the supply activity that generated the order. Excluding backorder time or time delays resulting from nonavailability in the wholesale supply system enables a focus on a distribution performance. The left y-axis shows the average RWT or distribution time for each channel, and the right y-axis indicates the average transportation cost per pound. The MILALOC channel is divided into two populations: shipments from SDP inventory (MILALOC-SDP) and shipments from other sources of fill (MILALOC-other), because they differ in performance. For OIF and all of CENTCOM, the SDP is Defense Distribution Depot Susquehanna, PA (DDSP).

MILALOC, when materiel is issued from the supporting SDP, offers fast service, averaging just over 10 days, at a moderate cost of $3.40 per pound (lb.).[1] The speed is similar to that of WWX, which costs about $10/lb. for shipments to customers in Iraq. Of note, the WWX rates to Iraq are much higher than the WWX rates to Germany and Korea. Surface-theater[2] also has similar speed, at about half the cost per pound of MILALOC assuming the use of intratheater air for delivery. So there are three "fast" channels at different transportation "price points" for customers in Iraq.

In contrast, the MILALOC channel (when the shipment is issued from a source other than a SDP) and the MILAIR channel are slower at about 19 and 24 days, respectively, at the moderate military-managed air price point. Surface-direct is very slow, averaging 72 days, but inexpensive. It should be noted that the surface-direct case does not include the theater truck transportation costs. Intratheater truck delivery is also an alternative for the surface-theater channel.[3]

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[1] This is the price charged by USTRANSCOM to the service to which the ordering unit belongs or charged to DLA (which then passes on the charge to the service). It is a transfer price intended to reflect the marginal cost to the government, less a small subsidy to USTRANSCOM. Price tables are periodically adjusted based upon changes in operating costs, such as the cost of fuel. WWX costs are based upon contracts negotiated by Air Mobility Command.

[2] The theater warehouse is in Kuwait.

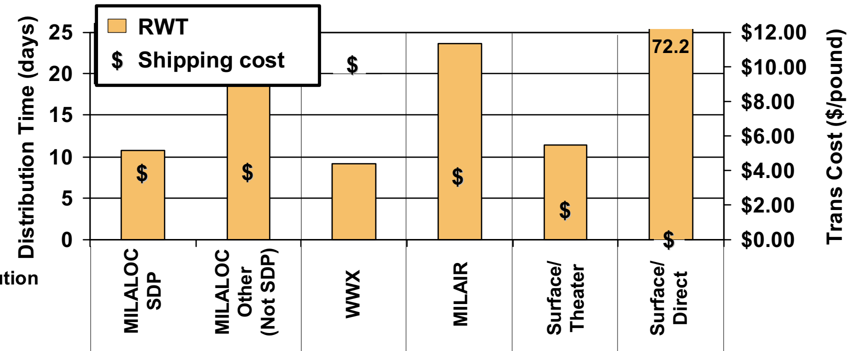
[3] We do not have good data on the cost of intratheater truck transportation.

B. Channel "Prerequisites"

The Channels Provide Complementary Capability and Cost Tradeoffs

March 2006
Iraq
All services
All requisitions

DDSP = Defense Distribution Depot Susquehanna, PA (SDP for Iraq)



	MILALOC SDP	MILALOC Other (Not SDP)	WWX	MILAIR	Surface/ Theater	Surface/ Direct
Distribution speed	Fast	Med	Fast	Med	Fast	Slow
Transportation cost	Med	Med	High*	Med	Lo-Med	Low
Inventory/warehouse costs	Lower	Lower	Lower	Lower	Higher	Med
Stock at SDP	X					
CCP-eligible item	X	X				
High-volume unit	X	X				
Up to 150 lbs.			X			
Not CCP or WWX-eligible				X		
High item-weight-to-cost ratio					X	
Inexpensive/time insensitive						X

RAND *Lower cost/similar to MILALOC in developed regions: Germany, Korea Global supply chain -14

The performance and transportation costs for each channel are not alone sufficient to determine whether one channel or another should be used. Rather, there are "prerequisites" for either feasibility or effectiveness. To use MILALOC to ship an item, the CCP must be capable of handling and packaging the item or, in other words, it must be CCP-eligible. Non-CCP-eligible items include hazardous, oversized, and sensitive items. For MILALOC to be effective from a speed standpoint, pallets have to be built for individual supply activities, limiting theater distribution to transshipment and movement rather than break bulk and resorting activities. Thus, for MILALOC to be efficient while limiting pallet materiel accumulation hold time, the unit has to need sufficient materiel volume to be filled from CONUS sources to generate reasonably full pallets on a frequent basis (e.g., every day). The Air Mobility Command minimum pallet target weight is 3,000 pounds for airlift cost efficiency. Finally, for MILALOC to be fast with current processes, the stock needs to be positioned at SDPs. This avoids multiple additional handling and transportation within CONUS.

WWX is currently limited by contract to items 150 pounds or less.[4] MILAIR can handle anything that can be shipped by air. As it is slower than MILALOC and costs about the same, it would only make sense to use it for items for which MILALOC is not a choice. With regard to WWX and MILAIR, there is a cost-versus-performance tradeoff that could influence the decision when the item is WWX-eligible. Also, especially early in a war, WWX may not be able to deliver to all locations.

When considering surface transportation overseas, another factor must be considered. Filling containers and putting them into the slow distribution channel either requires additional total system inventory or reduces stock availability by temporarily making inventory in the channel unavailable for issue. Similarly, theater stock requirements can further increase total inventory requirements to achieve a global stock availability target. Thus, the added inventory cost of using surface channels must be considered along with transportation cost. Total system cost is reduced when high-weight-to-cost materiel is stocked forward in theater with replenishment by sea, with significant value gained when these items are also high volume. However, the total inventory and transportation cost of the surface-theater channel is actually higher than MILALOC or MILAIR for items with a low weight-to-cost ratio. For example, even though it costs a lot to send tank engines by air overseas, it would cost even more to buy enough to fill the surface pipeline and maintain theater inventory. Thus, surface-theater and MILALOC offer similar performance, but they are cost-effective for different sets of items.

Finally, surface-direct is too slow and variable to be used except for cases in which delivery timing is not important or planning offers a very long lead

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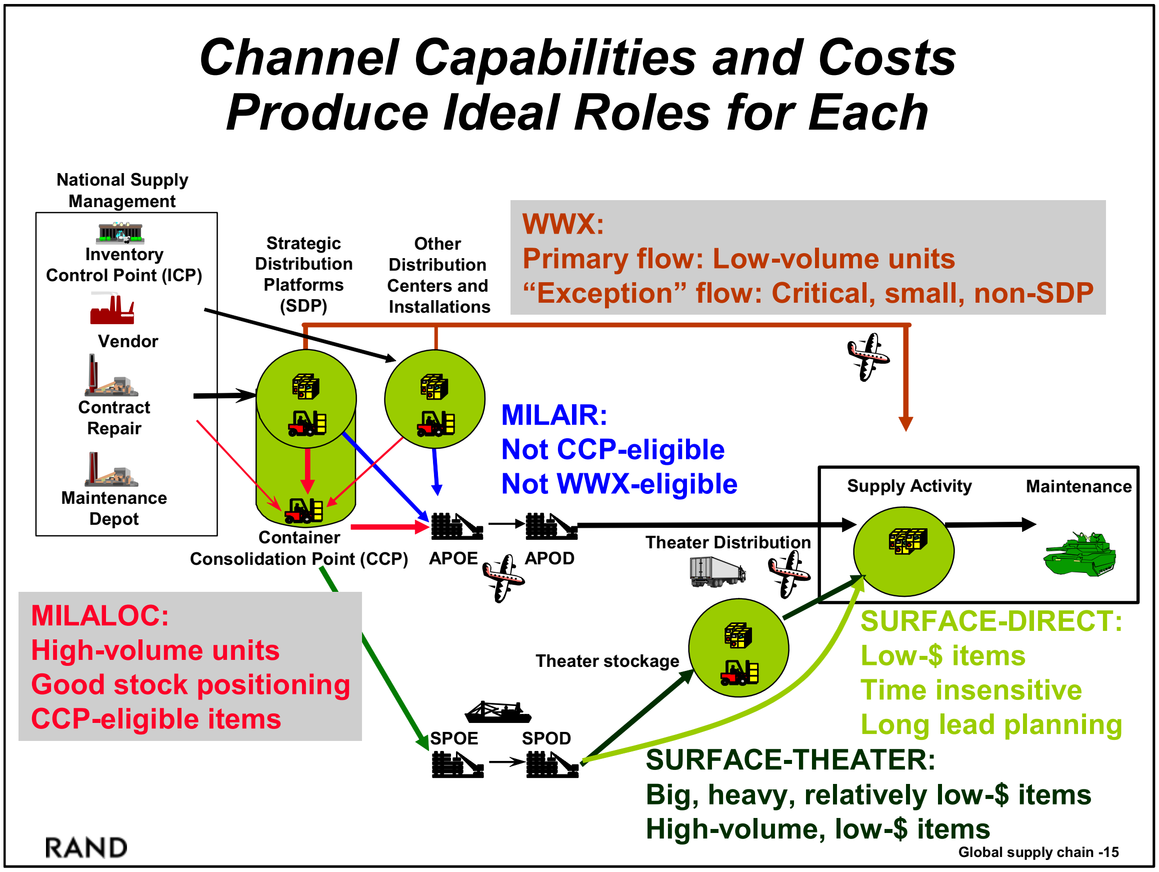
[4] At the request of the four services, on December 1, 2006, USTRANSCOM let contracts for International Heavyweight Express (IHX), essentially an expansion of WWX covering 151 to 300 pounds. This is a test program that will be reevaluated after eighteen months.

time. Again, this channel would be relatively expensive from a total cost standpoint for expensive items.

4. Ideal Distribution Channel Roles



By considering the combinations of performance, transportation cost, inventory cost, and conditions under which the channels are feasible and effective, we can derive ideal roles for each. Surface-direct is the best choice for relatively low-cost items ordered in bulk either for time-insensitive needs or when the unit can plan associated activities far in advance. Surface-theater is the best way to provide high-volume, high-weight-to-cost items to all units in theater.[1] Time-sensitive demands for items for which it is not cost-effective

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[1] For units in Iraq, theater inventory has not been providing a time advantage over MILALOC from the primary distribution center. Thus, it has primarily offered a

from a total cost perspective to hold in theater inventory should be sent by air from CONUS sources of fill.[2]

For air shipments from CONUS, MILALOC works well and is the ideal choice for units with moderate to high volume sustainment needs when stock is positioned to a large degree at the unit's supporting SDP. Even for these units, though, MILALOC cannot handle all items, requiring a fallback to MILAIR for non-CCP-eligible items. Also, some items will not be stocked at SDPs for MILALOC customers. In these situations, WWX becomes an alternative for fast, reliable distribution from non-SDP sources of fill when the situation so demands.[3]

For units with low requisition volume or stock positioning that will not support effective MILALOC, the only way to get fast, reliable distribution is WWX, which becomes their ideal channel. For items over 150 pounds sourced from within CONUS, though, these units currently have to rely on relatively slow MILAIR, even to meet critical needs.

Thus, customers get responsive distribution—fast and reliable when needed—and total system costs are minimized when high-volume, high-weight-to-cost items are stocked in theater with enough depth to support replenishment by ship, the vast majority of items for high-volume customers

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transportation cost savings. However, if in another theater it were to have a time advantage, then it could be advantageous to expand the breadth of items to improve customer support effectiveness. Similarly, it can provide a time benefit for items that cannot use MILALOC from the primary distribution center or WWX. In such cases, if the item does not meet the weight-to-cost criteria for theater inventory, then it may still be beneficial to hold it in theater inventory but with air-based replenishment to hold down inventory requirements.

[2] Time-sensitive demands include local inventory replenishments, as lengthy and unreliable replenishment would drive up tactical or other retail inventory requirements.

[3] As WWX is cost competitive with MILALOC in Germany and Korea, the choice between it and MILALOC for high-volume customers supported by good stock positioning is less about cost. For high-volume customers in these regions, MILALOC would still be the first choice because it can handle most items, whereas WWX can only handle relatively small ones. Using a mix of the two for SDP-sourced shipments would increase the number of receipts arriving at supply activities without a distribution time advantage.

are stocked at SDPs, and customers plan activities involving large volumes of inexpensive materiel far in advance.

The push items referred to at the beginning of this document are generally procured locally or pushed forward from theater inventory, which is replenished by surface transportation. They are only flown to theater when national supplies become very short and the surface pipeline cannot be filled.

5. Current Support Structure Design: A Unit View

Through a gradual but ad hoc evolution, the actual sustainment structure for OIF is beginning to match the ideal supply chain model. To illustrate how it is working in practice, we look at different unit types, starting with an actual Army heavy brigade combat team (BCT) in Iraq.

A. Qualifying for MILALOC

Fast and Inexpensive, MILALOC and Surface-Theater Are Preferred for Units That Qualify

- **Key criteria for units to use MILALOC**
  - **Most needed materiel positioned at SDPs (SDP %)**
  - **Moderate to high volume (Pallets/day)**
  - **Most materiel eligible for palletization at the CCP**
  - **Composite: daily, reasonably sized pallets from the SDP**
    - **Metric: SDP pallets/day**
  - **Typical unit type meeting these criteria:**
    - **Army Brigade Combat Team, Army Sustainment Brigade, USMC ground unit**
- **Will discuss surface-theater criteria in next section**

	Heavy BCT High volume High SDP%
SDP Weight/N %	73/72 (2 SDP)
Pallets/Day	3.2
SDP Pallets/Day	1.7

} Potential at average pallet weight

Units in Iraq, Jan to Mar 06

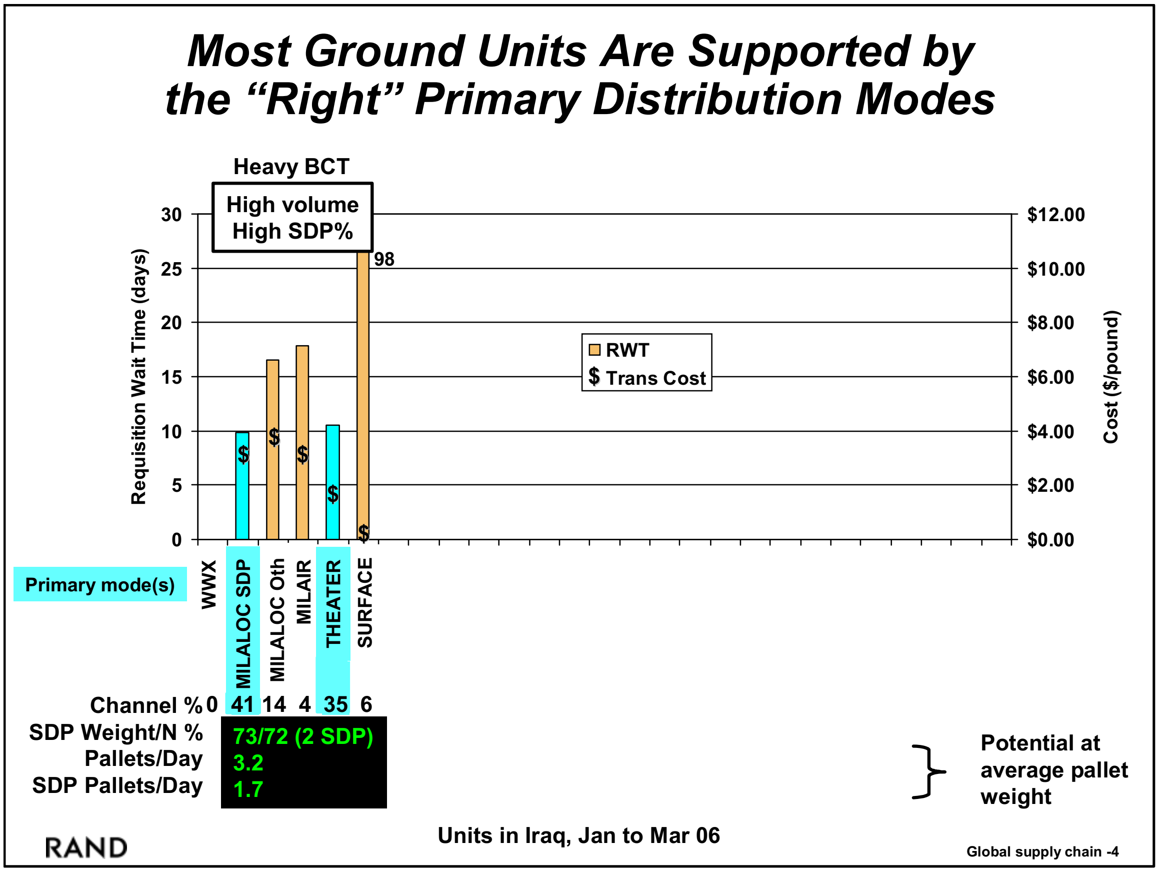
RAND

Global supply chain -3

When volume and stock positioning are both “high enough,” the best distribution choice for items shipped from CONUS for units in Iraq is MILALOC. Thus, to determine if a unit qualifies for MILALOC, we first look at total volume per day requisitioned and filled from CONUS sources, in terms of potential pallets per day, which is 3.2 for the heavy BCT given an average pallet weight of 4,500 pounds. The next check is to see how much of these items in terms of weight are issued from the SDP. In this case, it is 73 percent of weight, representing 72 percent of the shipments. However, the heavy BCT has an advantage, as effectively two CCPs are building pallets for it given where the items it needs are stocked as well as its high volume.[1] The third check is to see how much of the materiel issued from the SDP (and the second distribution center with a collocated CCP-like operation) is CCP-eligible. After taking out non-CCP-eligible items, 1.7 pallets per day worth of materiel that is CCP-eligible and stocked at a SDP is ordered by the BCT. This is a high-volume unit with sufficient stock positioning to support effective MILALOC. Of note, though, the stock positioning is good enough only because two distribution centers are being used as SDP-like operations with CCPs for this BCT.

[1] While not officially an SDP, Defense Distribution Depot Red River, Texas (DDRT) builds pure pallets for select high-volume units. These are generally heavy BCTs, because DDRT stocks many of the larger items these units need.

B. High-Volume, High SDP% Example: Army Heavy BCT



As it should be, MILALOC from the SDP is the primary channel for the heavy BCT for shipments from CONUS. One sees, though, that one-fourth of the MILALOC shipments have to first be shipped from another distribution center to the SDP—MILALOC-other—suffering a six-day time penalty on average. A small percentage of shipments have to go by MILAIR, because they are not CCP-eligible; they face an average time penalty of about 8 days versus MILALOC-SDP. Another small percentage of shipments go surface-direct to the BCT, taking an average of 98 days.

A heavy BCT also orders a large number of high-weight-to-cost items that are good candidates for centralized theater inventory with surface replenishment (surface-theater). Thus, surface-theater should also be a major channel for a heavy BCT, as is the case here.[2] The service is similar to MILALOC-SDP. What is shown here in surface-theater actually combines two theater sources. One is Defense Distribution Depot Kuwait, Southwest Asia (DDKS), which is planned to provide the big, heavy, relatively inexpensive items, and it is replenished by surface. The other is the Army GS SSA in Kuwait, which receives serviceable returns and then fills orders from retention stocks. These might be termed theater inventory "opportune" fills. While not meeting the earlier definition of surface-theater, they have essentially the same transportation cost.

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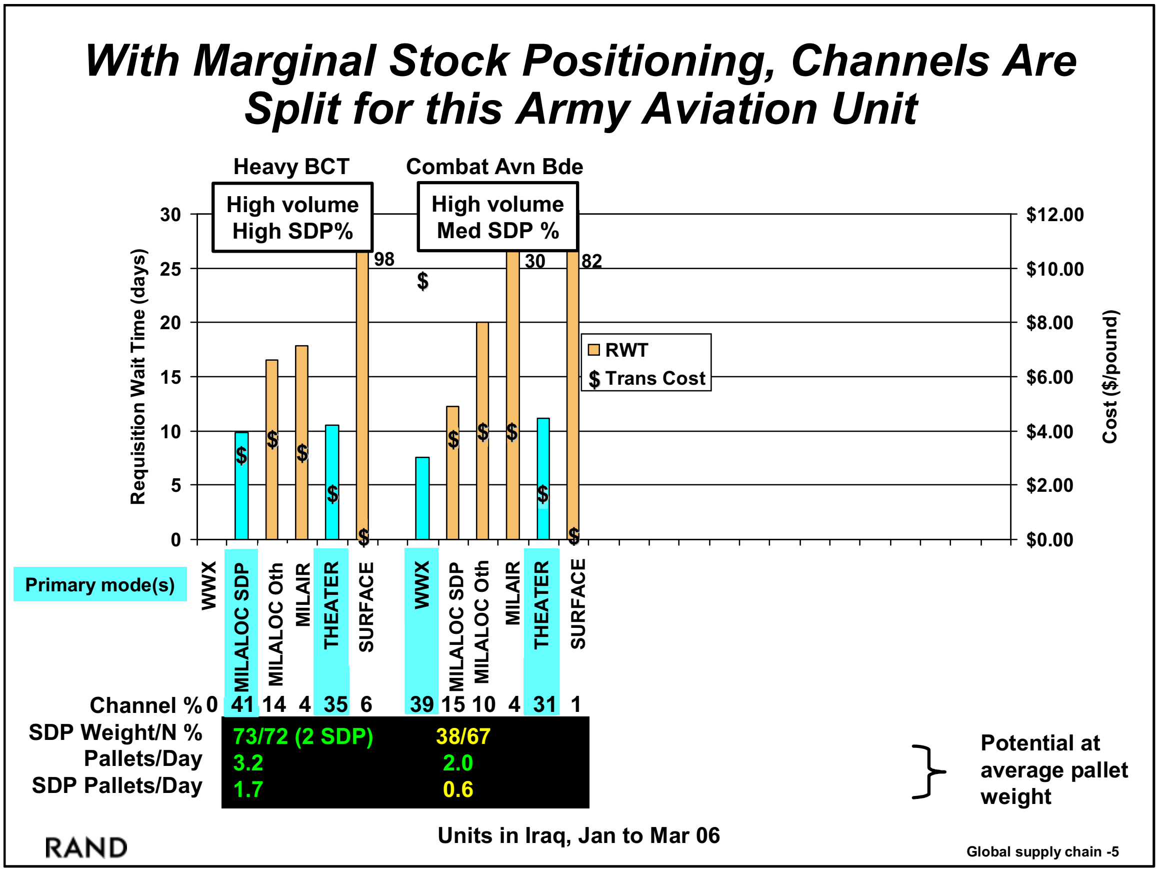
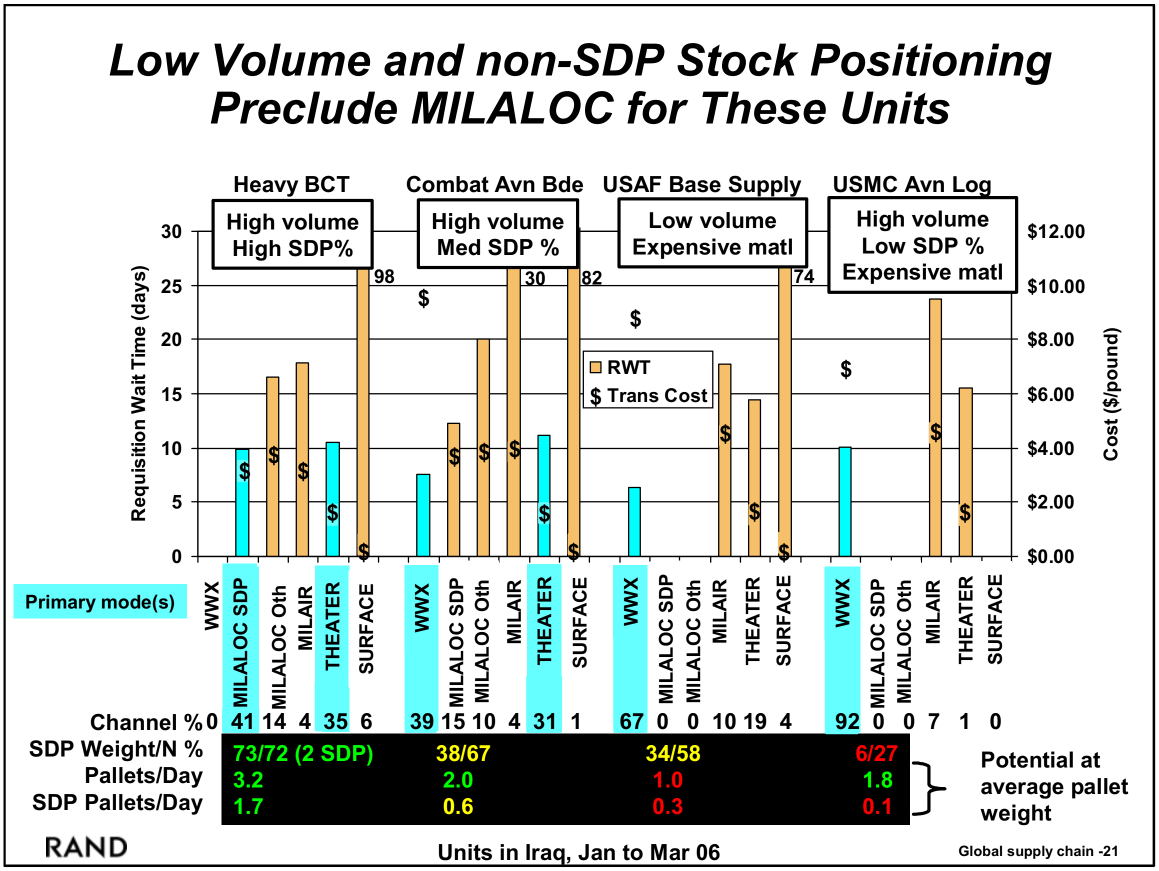
[2] However, these 35 percent of shipments include a large percentage of small, light items for which theater inventory provides relatively little benefit.

C. High-Volume, Med SDP% Example: Army Combat Aviation Brigade



This chart adds an example Army combat aviation brigade (CAB). It also has relatively high demand volume, averaging two pallets worth per day. However, only one distribution center acts as a SDP with a CCP for the CAB, with just 38 percent of the shipment weight for the CAB sourced from the SDP. Hence, on average, only 0.6 pallets per day are generated, which, with variability, drives up hold time at the CCP to build pallets. Hence, MILALOC-SDP performance is not quite as good, and 40 percent of MILALOC shipments fall in the MILALOC-other channel with a 20-day RWT average. More problematic for the CAB is that 4 percent of its shipments are shipped via MILAIR with an even longer average RWT of 30 days. The CAB's unusually long MILAIR RWT (the overall average for Iraq is about 24 days) is driven up by special items, such as helicopter rotor blades, that have to go on military airlift as opposed to commercial airlift. Military air is more constrained and subject to being used for other purposes, driving up the time for these shipments, including those that are high priority.

To compensate for these performance issues, the CAB receives WWX for small items, with excellent but relatively expensive performance. This is its primary channel from CONUS in terms of shipment percentage, with the bulk of the weight going by the military air channels. The second major channel for the CAB is from theater inventory.



To further illustrate how the system is configured and works differently for different types of units, this slide adds examples of a U.S. Air Force (USAF) base supply unit and a U.S. Marine Corps (USMC) aviation logistics unit.

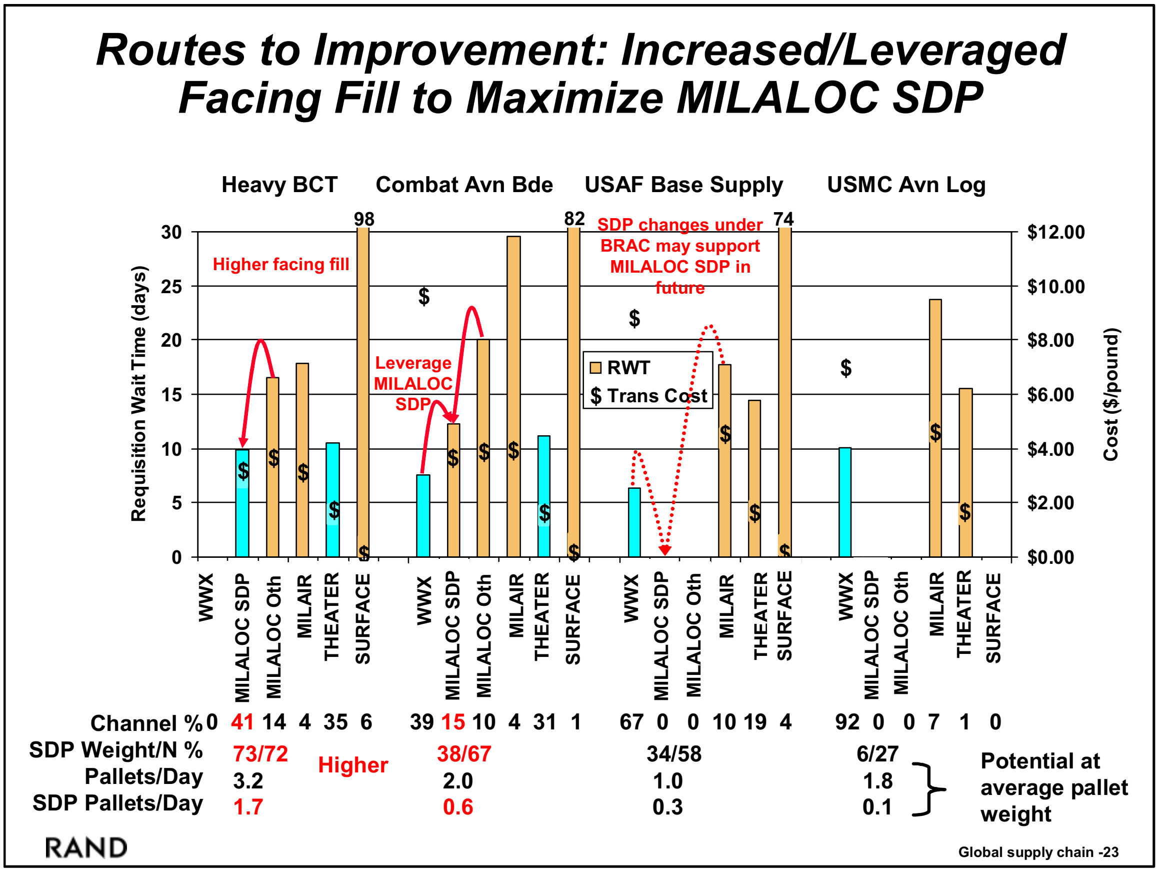
D. Low-Volume Unit Example: USAF Base Supply

The AF unit has relatively low volume and similarly low facing fill as the Army CAB. Hence, there is insufficient SDP volume for MILALOC consideration. Thus, the primary mode from CONUS is WWX, with MILAIR as the fallback for non-WWX-eligible items. These shipments, about 15 percent of the CONUS-sourced total, suffer about a 12-day delay versus the unit's WWX shipments. It also receives a substantial number of shipments from theater inventory.

E. High-Volume, Low SDP% Example: USMC Aviation Logistics

The USMC aviation logistics unit actually has relatively high volume, but almost none of the shipments in terms of weight are sourced from the SDP. This would make MILALOC ineffective. Hence, it too uses WWX as the primary mode. Again, the fallback option of MILAIR results in a substantial time penalty—14 days more than WWX. Unlike the other units, theater inventory fills a very small percentage of the unit's demands.

6. Routes to Improvement: Unit View



The next few slides examine near-term options for even more effectively using the supply chain model to improve sustainment to improve support to units in Iraq.

A. Improve Stock Positioning to Maximize MILALOC SDP

First, increasing the SDP breadth and potentially the depth of items that Army units and USMC ground units that use MILALOC need would shift shipments from the slower MILALOC-other channel to the faster MILALOC-SDP channel with no change in transportation cost. This depends upon healthy national stock availability to execute. Moreover, this would have the potential to improve MILALOC-SDP time for the CAB and other units with similar volume and stock positioning profiles. If this were to occur, then shifting the CAB's WWX shipments to MILALOC-SDP could be considered as a performance-neutral cost-reduction measure. To measure progress, SDP weight percentage, SDP pallets per day, and MILALOC-SDP time should be employed.

With the low USAF unit volume and the extreme misalignment between the SDP structure and inventory needed to support the USMC aviation unit, it would be difficult to change stock positioning sufficiently in the near term to make MILALOC an option. However, a different option would be to consider combining their shipments with a collocated supply activity. In particular, the USAF unit in this example is at a location with large Army SSAs. For the longer term, BRAC 05 creates two new SDPs, which have significant amounts of USAF-owned and DLA-managed, USAF-oriented inventory, potentially making MILALOC more of a future USAF option.[1]

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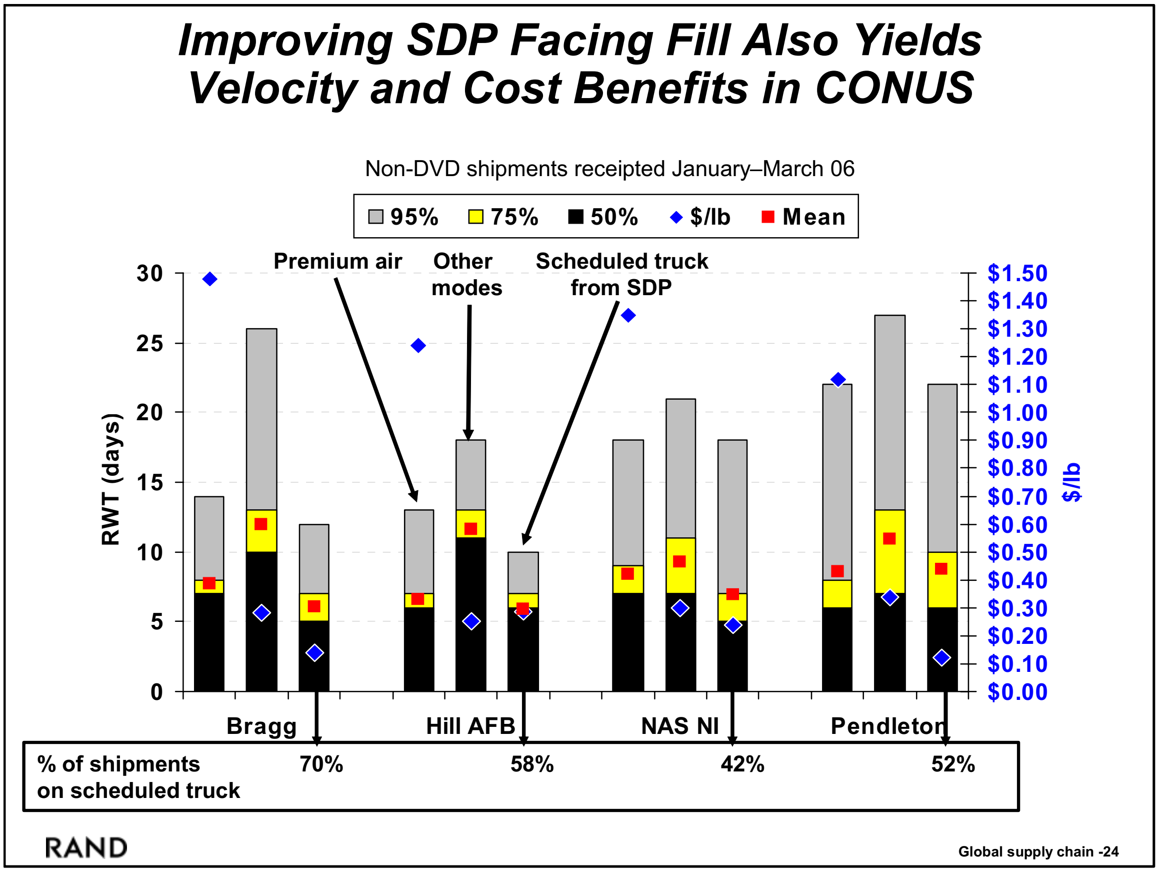
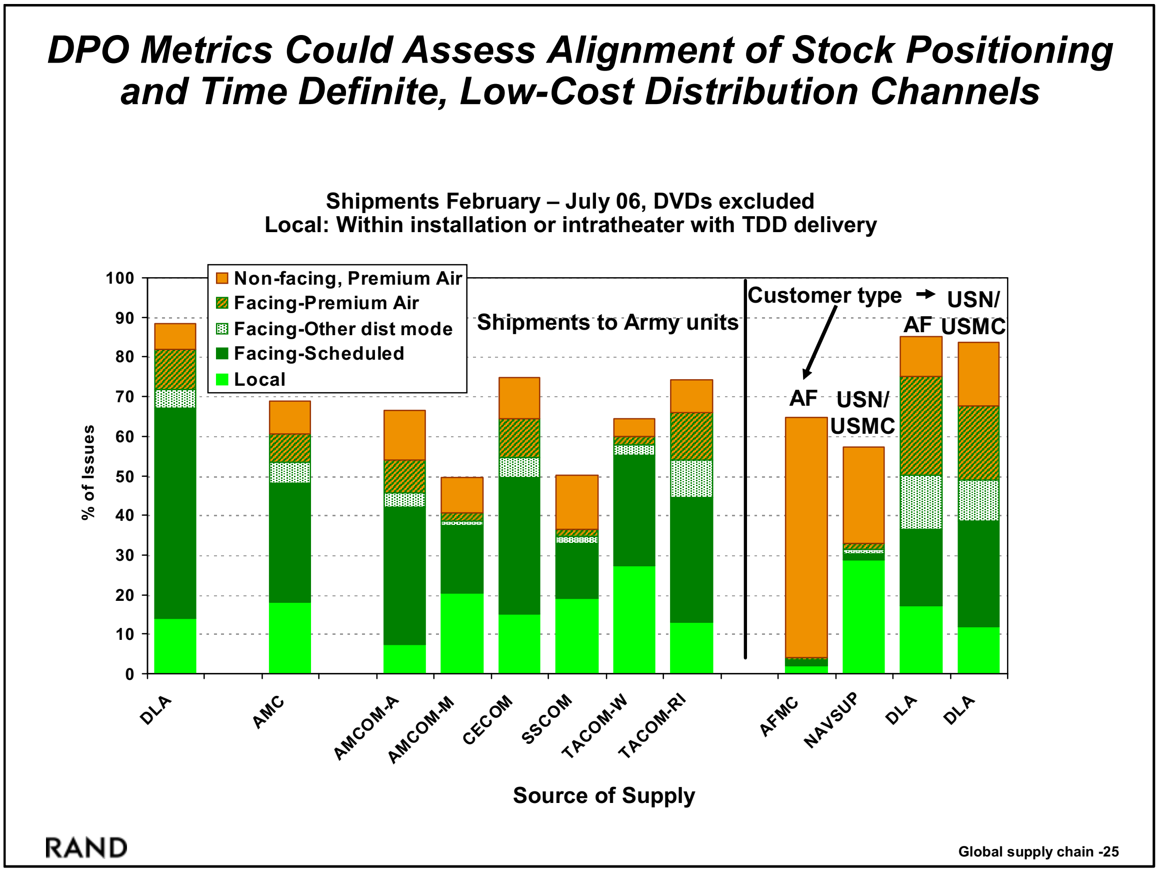
[1] *Department of Defense Base Closure and Realignment Report*, May 2005.

CONUS Benefits of Good Stock Positioning



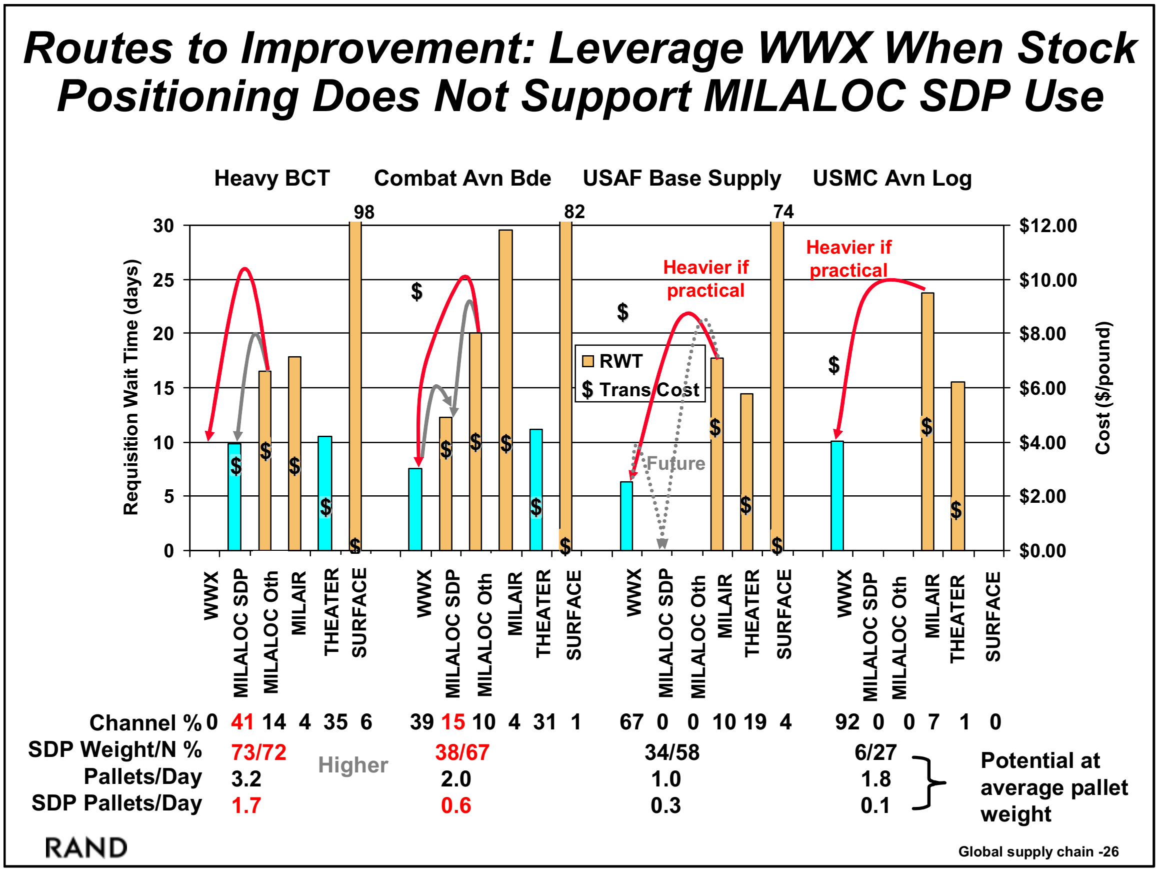
SDP stock positioning also pays large dividends in CONUS. This chart shows distribution time and transportation cost per pound for shipments to four CONUS installations. The columns show RWT using the left y-axis scale. For each installation the first column reflects premium air performance, the second shows other modes such as less than truckload, and the third shows scheduled trucks from the SDP, which are used when items are sourced from the SDP. The height of the lower segment of each column shows the median time, the height of the middle segment shows the 75th percentile time, and the height of the column shows the 95th percentile. The diamonds depict transportation cost per pound, using the right y-axis scale. The percentages at the bottom show the percentage of shipments coming from the supporting SDP on a scheduled truck. *One sees that scheduled truck performance is as* *good as or better than premium air performance at much less cost, and its performance is much better than the modes in the other column at similar or less cost.*

Stock Positioning Metrics



To help guide and assess stock positioning improvement efforts, stock positioning metrics are critical. The goal is relatively low-cost, time-definite distribution. This is achieved through what are called local fills and stock positioned at the originating points of scheduled distribution channels. The height of the green segments, local plus facing fill, indicate the percentage of shipments that meet these stock positioning criteria, with the source of supply (organization that manages the item) on the x-axis and the customer unit types indicated above the columns. So, for example, 82 percent of shipments of DLA items to Army units are local or "facing." The graph also shows the percentage of facing fills that are not shipped via scheduled, time-definite means or that use expensive premium air. The top segment of each column shows premium air, nonfacing shipments.

B. Leverage WWX When MILALOC SDP Unavailable



The next option to improve support would be to increase the use of WWX when stock positioning does not support effective MILALOC. There are two different cases for this route to improvement. The first is to use WWX to sustain units that do not currently leverage this option to ship them high-priority, low-weight shipments filled from non-SDP locations. For these examples, this would mean using WWX for the heavy BCT for high-priority orders for which stock is not at the SDP and the item is WWX-eligible. This case would result in a small overall transportation cost increase. As it would apply to low-weight shipments from current non-WWX units, this would affect only about 1 percent of the total weight shipped to OIF.

The second case would be to try to shift more shipments away from the slow MILAIR channel for current WWX-centric units. This could be done by increasing the weight limit of WWX shipments.[2] Perhaps surprisingly, this would probably have little effect on transportation costs for these moderately heavier items.

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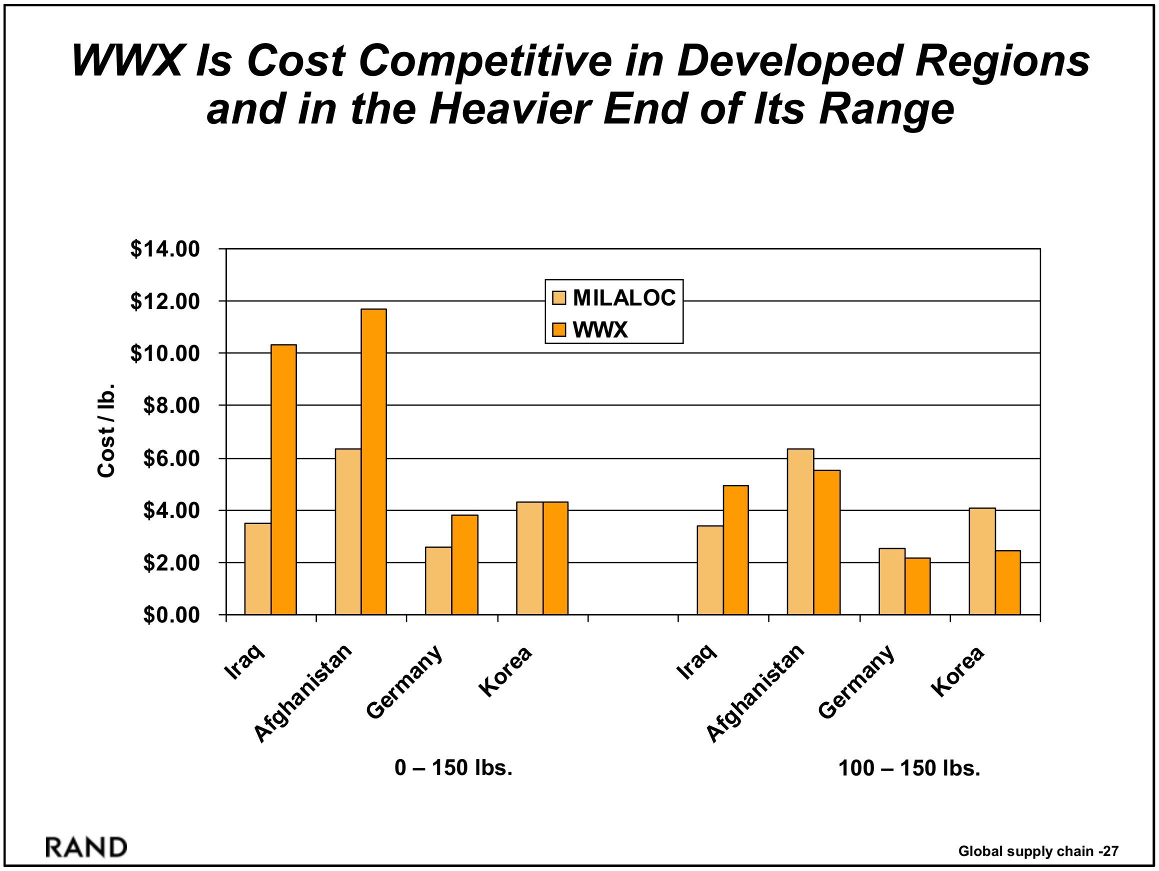
[2] The new IHX program will extend WWX-like support for items up to 300 pounds.



This chart lays out MILALOC and WWX average cost per pound by theater, for the overall WWX weight population, and then limiting the population to items between 100 and 150 pounds. In the high end of the WWX weight range, there is little cost difference to Iraq between MILALOC and WWX, and WWX actually becomes slightly less expensive in the high end of the range to Afghanistan, Germany, and Korea. Thus, if feasible, we hypothesize that expanding the weight limit above 150 pounds would likely produce little change in transportation costs for the items involved. To confirm this would require discussions with the WWX carriers to determine what the prices would be and whether they would be able to provide the same performance for higher-weight items.[3]

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[3] In December 2006, IHX rates were released with a flat rate per pound from 151 to 300 pounds. The rates, which vary somewhat by carrier ($4.04 and $4.50 per pound for the

The chart also shows the effect of having an established infrastructure on WWX costs, which are much lower for Germany and Korea than for Iraq and Afghanistan. From this standpoint, the choice of modes for these theaters, then, will come less down to cost between WWX and MILALOC.

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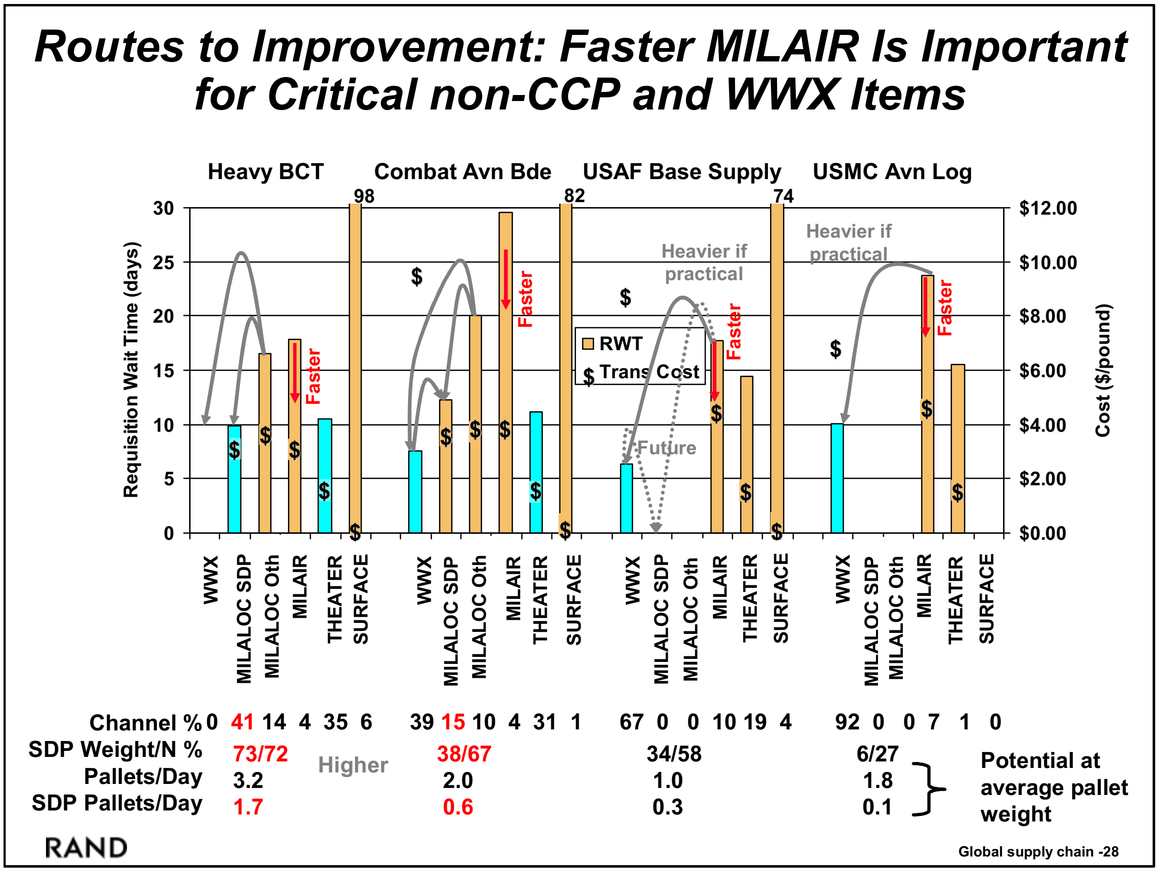
two main WWX carriers to Iraq), are about the same as MILALOC (average of $4.16 from June through November 2006), while MILAIR has averaged a little more at $4.76 in the same period.

C. Faster MILAIR for Critical Non-CCP and WWX Items



The option to increase the use of WWX is designed to minimize MILAIR use. However, MILAIR will remain the only currently available choice for some heavy, outsize, sensitive, and hazardous items.[4] At times, this set includes high-priority shipments. Thus, it would be valuable to rigorously examine the MILAIR process to identify potential improvement paths. Another alternative, lacking success in such an effort, would be to position these critical but difficult-to-ship items in theater inventory even when this would increase total

[4] The potential alternatives would be to change the capabilities of CCPs to handle these items when CCP handling is the only constraint and to develop special commercial arrangements with aircraft able to handle items that cannot be loaded through side doors. However, the commercial availability of the latter is very limited.

costs due to increased inventory expense. Since these items would not be forward positioned to reduce total costs, it would make sense to replenish them by air instead of surface.

7. Current Support Structure Design: An Item View

A. Current Theater Inventory Versus the Ideal

Theater Inventory Generally Includes NSNs That Are Inexpensive per Pound and Drive Shipping Weight

Stock numbers	Percent of total weight	Number with greater than 33% air shipments	Number with high air with potential savings from theater inventory add or increase
1–25	37%	3	3
26–50	10%	7	6
51–100	10%	20	20
101–1,000	25%	580	522
1,001 – 220,164	18%		

RAND

Global supply chain -32

The current sustainment structure for OIF reflects the ideal supply chain model when viewed not only from a unit perspective but also from an item perspective. Theater inventory should include items with a high weight-to-cost ratio, with a focus on weight volume drivers to reduce airlift costs and avoid potential airlift bottlenecks. To examine alignment with this ideal, we started by looking at the top 1,000 national stock numbers (NSNs) in terms of shipping weight to customers in Southwest Asia from May 2005 to April 2006. Then for each, we examined how much was shipped directly to customers via air channels from CONUS versus surface-theater and surface-direct. Finally, we compared air transportation costs for each NSN with an estimate of the inventory cost of forward inventory to roughly determine which NSNs should be stocked in theater and replenished by ship. The methodology used for this evaluation will be discussed later.

Of note, these 1,000 NSNs account for 82 percent of the total shipping weight. Not surprisingly, as this list is dominated by relatively heavy items, about 90 percent of them appear to make sense for stockage in theater inventory. Just 25 NSNs out of 220,000 shipped during the one-year period account for 37 percent of the total weight shipped. Three of these had more than 33 percent air shipments from CONUS, and all three meet the theater inventory criteria (i.e., added or increased forward inventory would reduce total supply chain costs). All three are stocked in theater but have not had enough inventory depth to meet 67 percent of demands or more with theater inventory. This is a relatively conservative threshold because, given that a particular item should be in forward stockage, one might reasonably strive to achieve 85 percent or higher fill from theater inventory. We also see that seven of the NSNs ranked 26 to 50 had relatively high air shipping percentages. Of these, six should be stocked forward in theater, and one is very expensive, so the inventory costs would outweigh transportation cost savings for this item, making the airlift cost-effective. For the next 50 NSNs, again, the results start to get a little more mixed, with 20 having air shipping percentages greater than 33 percent and meeting the criterion to be stocked in the theater. Over one-half of the remaining 900 NSNs on the list could see reduced total costs through improved or initiated theater stockage.

Overall, for these 1000 NSNs, only 19 percent of the shipments, by weight, have gone by air, because the heaviest-volume items that dominate the list have had relatively good theater inventory. Still, we estimate that with very good theater inventory for NSNs that should be in theater inventory (i.e., increasing theater inventory fill rates for these items to 90 percent), the air shipments of these 1,000 NSNs could potentially be cut about 67 percent further, to about 6 percent of the shipment weight for these NSNs, for an overall cut of more than one-third in total air shipments from 26 to 15 percent of the total weight shipped to customers. For May 2006 to April 2005, this would have cut the OCONUS airlift bill by about $130 million.

B. Theater Inventory Decision Methodology

Example Inventory vs. Transportation Cost Tradeoff Analysis: Stock Forward

Based on shipments, January 2006 – January 2007

- **NIIN: 014469498, NOMEN: Battery, Storage**
- **Weight: 89 lbs**
- **Unit price: $113, $1.27/lb**
- **Airlift cost: $328, $3.68/lb**
- **Transportation savings per battery issued from DDKS: @$181**
  - **Assumes $1.65/lb theater transportation costs from DDKS**
  - **Savings per year (60,309 batteries): $10,896,027**
- **Cost per year per battery added to inventory: $23**
  - **16% holding cost (based upon TACOM holding costs)**
  - **60-day + 30-day pipeline cost of inventory: $291,269**
- **Estimated issue (DDSP) and receipt (DDKS) costs: $141,393**
  - **Based upon FY06 net landed costs**
- **Total annual savings from theater inventory: $10,463,365**

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Global supply chain -45

Most of the benefit from theater inventory comes from stocking items that drive much of the shipping volume in terms of weight. However, not all relatively heavy items should be stocked forward in the theater from a total cost standpoint. Rather, the cost of any additional inventory needed to meet a theater fill rate goal can be compared to the transportation cost savings to make this decision. This chart walks through a rough analysis for one National Item Identification Number (NIIN)—a vehicle battery.

This battery weighs 89 pounds and has a price of $113, for a unit price per pound of $1.27. The airlift cost per pound from January 2006 to January 2007 averaged $328 per battery or $3.68/lb. based upon actual transportation tariff rates (transportation costs per pound vary among items depending upon how they tend to affect the mix of items on a pallet). The simple comparison of unit price per pound and airlift cost per pound provides a first-order indicator of whether it would be cost-effective to position an item in theater inventory. In this case, the $1.27 price per pound is extremely low and significantly lower than the airlift cost from CONUS—it costs more to fly the battery to Iraq than to buy the battery. Items in this price-per-pound range will always be cost-effective to stock forward, with significant savings accruing when they are high volume, as this battery is.

From January 2006 to January 2007, 65,335 of these batteries were shipped to the theater (rate of 60,309 per year). For batteries sent by ship to DDKS and then delivered via intratheater air, the transportation cost per battery is roughly $1.65/lb., for a transportation cost savings of about $10.9 million, compared to 100 percent strategic air delivery. If the batteries were to be shipped via ground convoy from Kuwait to Iraq, the transportation savings would likely be greater, but ground convoy security remains a significant concern.

To stock inventory in additional locations and achieve a constant level of global service measured in terms of stock availability and facing fill[1] from SDPs to the units they are designated to support while achieving high theater facing fill for the designated forward stockage items (i.e., enable a high percentage of orders to be filled from theater stock replenished by surface, limiting air shipments to the theater), requires some additional global inventory.[2] This depends upon the number of locations and the replenishment time for the locations. For this example, we assume that to take the 65,000 or so batteries out of the air channels would require filling a 60-day surface pipeline. Additionally we assume that the reorder point would be 60 days of supply with

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[1] Facing fill is defined as the percentage of shipments originating from the designated primary source of fill for a unit.

[2] If high facing fill does not remain a goal, then additional global inventory needs will be less, driven only by the stock aboard ships temporarily unavailable for issue. Stock availability can be maintained by shipping items from nonprimary sources of fill for a unit. However, for big, heavy items, this will tend to increase distribution times, increase transportation costs, or both, since airlift will generally need to be used for OCONUS shipments and scheduled trucks will often not be an option.

an order quantity equivalent to 60 days of supply, producing an average on hand of 30 days worth and an average of 60 days of supply in transit.[3] Data from the Army's Supply Performance Analyzer database indicates an average of 16 percent inventory holding cost for Tank-automotive and Armaments Command (TACOM) items, which we'll assume as the inventory holding cost in this example. This set of assumptions produces an annual inventory cost of about $291,000 for 90 days of inventory. Using DLA's net landed costs, we calculate that the six annual issues of these batteries from DDSP and receipts at DDKS would cost an estimated $141,000.

Thus, even buying additional inventory, increasing stocks in theater to eliminate this battery from the air channel would produce an annual savings of about $10.5 million.[4] The prerequisite for being able to do this is healthy national supply of the battery.

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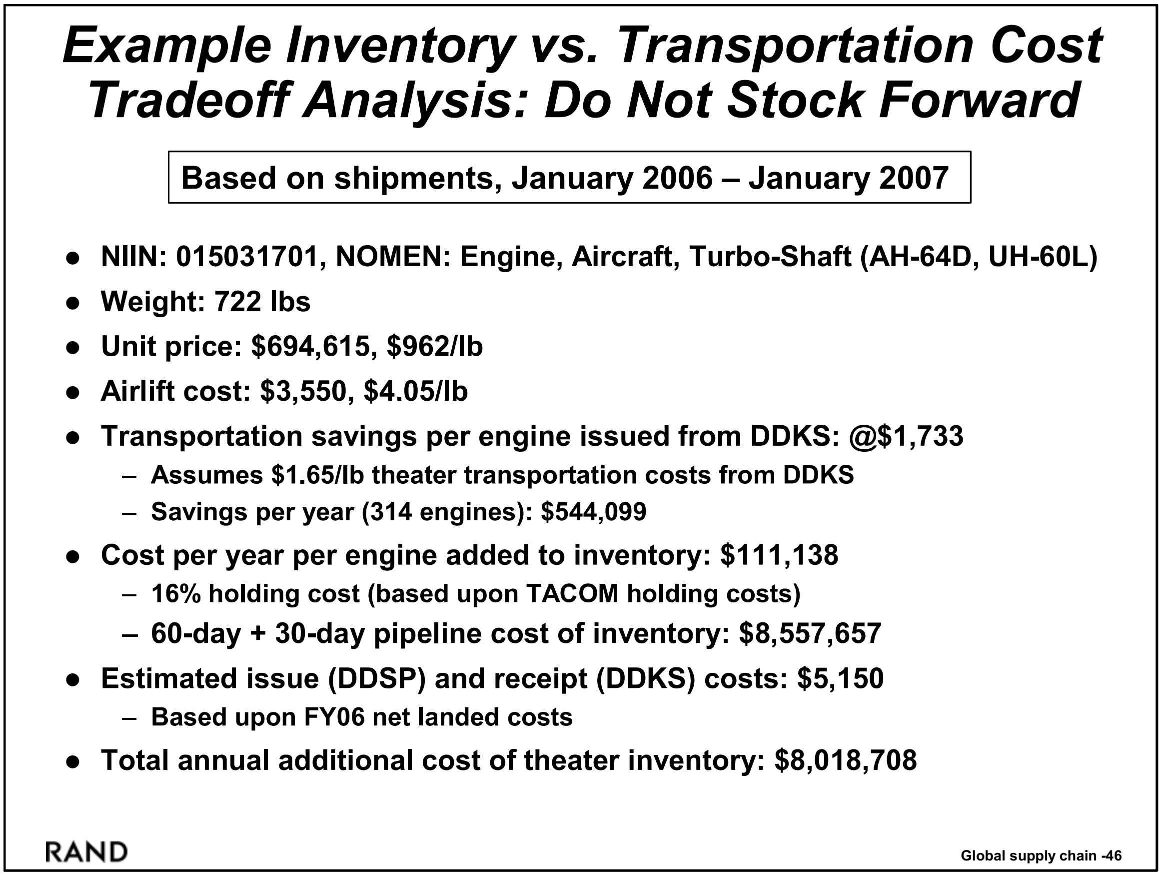
[3] In June, July, and August 2006, surface distribution time to supply activities in Kuwait averaged 64 days. In late 2003 and 2004, they had reached well over 100 days, with gradual improvement that brought times back to prewar levels by the summer of 2006.

[4] In subsequent research, we developed a comprehensive methodology for determining theater inventory requirements and have computed the specific inventory level needs by NIIN for DDKS. As of this analysis, DLA and some Army Materiel Command managers had not increased global inventory requirements specifically to support theater inventory at target levels. Nor have there been theater inventory facing fill goals for either DLA or service-managed items. Probably as a consequence of these issues, a large number of items stocked forward in theater also continue to have significant levels of air shipments to theater. This analysis suggests that it would be cost-effective from a total supply chain cost standpoint to increase global inventory somewhat to achieve high theater facing fill for designated items that should be replenished by surface.



This slide applies the forward theater inventory decision methodology to a contrasting example—an aircraft engine. Its unit price per pound is $962, much higher than its average airlift cost of $4.05 per pound. This first-level comparison indicates that it would be much more expensive to buy additional tank engines to position in theater inventory than it would be to ship them by air from CONUS. Using the same assumptions as for the battery example leads to an estimated $8.0 million annual total cost increase were this engine to be stocked in theater inventory at sufficient depth to avoid airlift. Thus, it would not be cost-effective to buy additional engines to increase global inventory in an attempt to offset transportation costs. A small, expensive electronic component would be an even more extreme case, with some at thousands of dollars or even ten-thousand-plus dollars per pound. Of course, these small, expensive electronics will not significantly affect airlift.

If, however, an item is in long national supply, and the true marginal cost of additional inventory to cover the surface pipeline and for theater inventory is zero, then it may make sense to stock these types of "nontheater inventory qualifying" items in theater as long as they remain in long supply.

C. Item Classes for Theater Inventory

Inventory Vs. Transportation Tradeoff Computations Produce Logical Classes for Theater Inventory

- **Clear cases that drive the theater inventory benefit**
  - Track
  - Construction and barrier materiel
  - Tires and wheels
  - Batteries
  - Packaged POL
  - Tents
  - Paper
- **Positive but more borderline theater inventory benefit**
  - Diesel engines (depending upon theater cost structure)
  - Some transmissions
  - Other relatively heavy or large automotive components

RAND

Global supply chain -37

These two examples were purposely picked as two items with relatively high levels of airlift costs but as clear contrasting cases of items that are and are not cost-effective to stock centrally in theater and replenish by sealift. As the cost difference between strategic airlift and intratheater distribution increases, items with higher costs per pound will become cost-effective for theater inventory. If sealift replenishment time were to be faster, items with higher costs per pound will become cost-effective for theater inventory, since less additional inventory would be needed.

Within any reasonable range of assumptions, items such as the battery will make sense for centralized theater inventory, given there is an enough overall volume to merit establishing such inventory. Other clear categories of items include track, construction and barrier materiel, tires and wheels, roadwheels, packaged POL (petroleum, oil, and lubricant) items, tents, and paper products. For Southwest Asia, diesel engines, some transmissions, and other relatively dense automotive components such as starters, radiators, and transfer cases would also make sense to stock in centralized theater inventory with respect to total supply chain costs. Among items that sometimes have relatively high airlift volume, most of the ones that would generally not be cost-effective to stock in theater inventory and replenish by sealift would be heavy aircraft components—aircraft engines, cold sections, transmissions, and rotor blades. These items range from about $140 to close to $1,000 per pound.

D. Establishing Standard Theater Inventory Business Rules

Business Rules and Standard Process for Surface-Theater Decisions Are Needed

- **Periodically review items to add / delete**
- **Focus on items with high shipment volume (total weight)**
- **Determine total cost impact**
  - **Determine transportation cost savings from sealift**
  - **Determine inventory cost of marginal inventory needed to support sealift-based replenishment and theater inventory**
  - **Determine additional handling costs**
- **Set local and global inventory levels to meet theater fill targets**

RAND

Global supply chain -35

To improve theater inventory, a standard process and business rules should be employed. They might reflect the approach described here. This would start with a periodic review of the alignment of theater inventory with the intent of the surface-theater channel. Thus, the key would be to focus on items with shipment volume by weight. The volume drivers will produce most of the benefit of theater inventory. Once this list is created, the next task is to determine which items would have lower total supply chain cost when positioned in theater inventory versus CONUS only. This would be done by comparing potential airlift cost, the marginal inventory cost to maintain adequate levels in theater, and handling costs. For those items for which the computation points to theater stockage, then it becomes important to ensure that theater stockage requirements are set to meet a high theater fill rate target.

Additionally, global stockage requirements should be adjusted as necessary to support these targets.

A second way of determining forward inventory requirements could be considered. Data show that there are some items that primarily go surface-direct. As such, they do not trigger airlift cost concern. However, they do have long lead times for units. This can increase supply activity inventory requirements. Items that go primarily by surface-direct could be considered for surface-theater, preserving the sealift transportation cost advantage but allowing for more reliable resupply to units. Examples of such items are tents, cleaning supplies, lubricants, and toilet paper.

8. Improvements and Future Needs

A. Good Process Performance and Control: The Bedrock of the Supply Chain

Improvements and Future Needs

- **Improvements**
  - **Distribution speed to Iraq, particularly MILALOC**
  - **Forward inventory of many big, heavy items**
- **Current needs and opportunities**
  - **Improved stock positioning at SDPs**
  - **Increased use of WWX when stock positioning does not support effective MILALOC use; examine potential for heavier weight limit**
  - **MILAIR improvement for high-priority, non-CCP and non-WWX eligible items**
  - **Surface distribution speed**
  - **Further forward inventory improvement**
- **Key issues**
  - **Achieving fast distribution from day 1 of a contingency**
    - **Distribution center surge capacity**
    - **Integrated load consolidation and theater distribution planning**
    - **Initial distribution for WWX-centric customers**
  - **Role of DLA vs. services in pre/early positioning of big, heavy items**
  - **Maintain high stock availability through a conflict**
    - **War reserve funding**
    - **Contingency obligation authority budgeting**

RAND

Global supply chain -39

The supply chain model laid out at the beginning of this draft and being leveraged today to a large degree to sustain units in Iraq depends upon good process performance—performance that is similar to or even better than that being achieved in support of operations in Iraq early in 2006. Early in OIF, distribution was much slower and less reliable. However, a variety of problems were corrected and processes improved over a span of three years to produce the relatively fast, reliable service seen for MILALOC, at least when materiel is stocked at the supporting SDP, by the spring of 2006. Similarly, the Army and the Defense Logistics Agency established centralized theater inventories to reduce airlift requirements.

B. Near-Term Improvement Opportunities

Beyond these improvements, there are additional opportunities for improved, cost-effective support. First, better stock positioning to increase facing fill at SDPs, thereby increasing the percentage of shipments in the MILALOC channel originating from SDPs (MILALOC-SDP), would reduce overall distribution times by shifting shipments from what we termed MILALOC-other and enabling improved MILALOC performance to units with marginal MILALOC-SDP volume. Support to MILALOC units can be further improved by using WWX to ship small, critical items from non-SDP sources of fill. The potential for heavier WWX weight limits should also be explored to mitigate the effects of relatively slow MILAIR performance for units for which WWX is the primary channel.[1] Still, there will continue to be critical, large items that will remain above any reasonable WWX weight limit, such as aircraft rotor blades. Support for these items will continue to suffer unless MILAIR is improved, an alternative channel such as a special commercial charter is established, or forward stock positioning is leveraged. This leads to two more near-term opportunities. Surface distribution times to Kuwait have improved but remain relatively lengthy; further improvements could reduce inventory requirements. Additionally, there remain some high-volume, high-weight-to-cost ratio items that should be stocked in centralized theater inventory to reduce total costs.

C. Longer-Term Supply Chain Planning Imperatives

The Need for Process Control and Effective Contingency Preparation

Longer term, the Department of Defense should think through the desired complementary use of distribution channels integrated with stock positioning plans for future potential contingencies. For this planning to be

[1] As noted, the IHX test program will raise the limit to 300 pounds.

effective, it is imperative for process performance to match (or be better than) planning assumptions. Thus, distribution performance needs to be relatively stable, with late 2005 and 2006 OIF-like performance achieved throughout. Major problems that led to early OIF distribution delays were insufficient distribution system surge capacity, misaligned distribution center load configuration and theater distribution system capabilities, and insufficient process monitoring and control capabilities to quickly catch problems.[2] While WWX was used early, it also was relatively slow early in OIF and in many cases will not be able to deliver to "frontline" units. In such cases, alternative plans will have to be available.

Improving the Effectiveness of Prepositioning Stocks

Initial theater inventory was lacking as the result of two problems: prepositioning shortfalls and a lack of good doctrine that could be applied by theater planners for what types of items should be stocked forward. The notion of focusing on big, heavy, or high-volume items with high weight-to-cost ratios should become part of doctrine for both prepositioned inventory and contingency planning.[3] Additionally, the Army continues to maintain prepositioned inventory of theater-level sustainment stocks, while DLA is also considering establishing such stocks. These plans should be reconciled.

Ensuring High Stock Availability

Finally, for the ideal supply chain model to be feasible, high stock availability is crucial. Limited stock availability lengthens overall customer wait time and prevents effective stock positioning—either forward in theater or at SDPs. Early in OIF this was a significant problem with respect to Army-managed items due to very limited war reserve funding for secondary items, limited and delayed contingency obligation authority provided to the Army

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[2] Eric Peltz, Marc Robbins, Kenneth Girardini, Rick Eden, and Jeffrey Angers, *Sustainment of Army Forces in Operation Iraqi Freedom: Major Findings and Recommendations*, Santa Monica, CA: RAND Corporation, MG-342-A, 2005.

[3] Ibid.

Materiel Command, and contingency repair parts requirements planning issues. These issues need to be addressed by the Army prior to future contingencies.

Effective supply chain planning must start with a vision for how the system should be structured. With roles and interactions well understood, each organization can then assess its performance with respect to the needs of the total system and can determine what it will take to provide effective support in future contingencies. Thus, the crucial value that this report provides is delineating complementary distribution channel roles and how they must integrate with stock positioning decisions. From this delineation, clear near-term opportunities fall out. As situations change and capabilities evolve, though, the ideal structure may change. Thus, the organizations involved should vigilantly track performance and periodically assess whether beneficial structural changes may exist. They should also continually strive to find ways to more effectively operate, utilize, and integrate the channels and stockage planning.

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